Appendix E

Risk Management Plan
for
The BNL Center for Functional Nanomaterials

At
Brookhaven National Laboratory
Upton, New York 11973

January 14, 2003

Table of Contents

1. Introduction

Risks anticipated for the Brookhaven National Laboratory (BNL) Center for Functional Nanomaterials (CFN) project will be managed using a tailored approach in accordance with the methodology identified in the DOE Order for Program and Project Management for the Acquisition of Capital Assets, O 413.3. The CFN risk management plan (RMP) identifies the scope of the project's risk definition and delineates the methodology that has been used to identify, quantify, and assess risks. The level of treatment is graded based on the level of risk determined. The RMP identifies the controls and processes used to identify and mitigate areas of cost, scope, schedule, and technical risk that may occur during project planning and implementation. The RMP will be maintained and updated throughout the life of the project.

2. Project Summary

The project scope includes the design and construction of a laboratory building and the acquisition of the requisite instrumentation to support the targeted nanoscience thrust areas and laboratory functions.

The CFN structure will be a two-story building housing clean rooms, wet and dry laboratories, office space for BNL staff and users, and conference rooms. The building will incorporate human factors into its design so as to encourage peer interactions and collaborative visits between BNL staff and users. In addition to offices and laboratories, it will house "interaction areas" for informal discussions and lunch rooms on each floor to foster scientific discourse. This design approach is commonly regarded as the state-of-the-art in research facility design. Material and system selections will address the principles of sustainable design to insure low energy and maintenance costs over the life of the building. Design features will be incorporated into the building design that account for the sensitivity of nanoscience instrumentation, i.e., vibration isolation, temperature controls to +/- 1.0 degrees F, and shielding from electromagnetic interference.

The CFN will operate through major laboratory clusters: including facilities for nanopatterning fabrication, ultrafast short wavelength sources, electron microscopy, materials synthesis, proximal probes surface characterization, theory and computation, and an endstation at an NSLS beamline optimized for

nanoscale characterization using small angle scattering. An initial set of scientific equipment for these laboratories will be purchased as part of the project. The NSLS provides a wide range of imaging, spectroscopy, and diffraction/scattering techniques. In order to take advantage of these features, including the NSLS endstation, the CFN Users will have assured access to a suite of existing beamlines at the NSLS including: soft x-ray microscopy beamlines; UV, soft and hard x-ray spectroscopy beamlines; soft and hard x-ray scattering beamlines; an infrared spectro-microscopy beamline; an undulator insertion device microprobe beamline; and an undulator insertion device nanoprobe beamline. The BNL Center for Functional Nanomaterials will be a structure integrated with the existing NSLS and Instrumentation facilities to complement the existing functions of these facilities. Siting of the Center will take advantage of proximity to the Instrumentation Division (Building 535), the Physics (Building 510), Materials Science (Building 480), and NSLS (Building 725) Departments, which are key interdisciplinary participants in nanoscience research.

3. Risk Assessment Methodology

The CFN Project Manager has overall responsibility for implementing the RMP during the design and construction phases of the project. However, the expertise and resources of the entire Integrated Project Team will be used as appropriate. The methodology that was used for the CFN RMP was as follows:

(1) The categories of the project WBS scope, i.e., project management, design engineering, and technical/conventional construction were examined for potential areas of risk uncertainty. Examples of the areas considered were project scope, acquisition management, cost estimating, schedule control, budget management and technical design, and environment, safety and health risk.

(2) A qualitative risk assessment was conducted by determining a) the potential impacts of occurrences/issues related to the areas of consideration and b) the likelihood of occurrence. Impacts are characterized as *Low, Moderate, High* and likelihood of occurrence is characterized as *Unlikely, Likely, and Will Occur*. Examples of impacts considered were scope “creep”, cost over run, schedule slippage, and poor technical design.

(3) All areas of consderation were evaluated by the Integrated Project Team and subject matter experts participated as necessary. Mitigation management strategies were considered, evaluated and selected on a graded approach based on the risk assessment results. The project execution plan, acquisition plan, cost estimates and schedule have all been prepared with an awareness of project risks and risk mitigation strategies have been incorporated to the maximum extent feasible.

4. Tracking and Closeout Process

Each risk mitigation strategy that has been selected for effective risk management has been assigned to a responsible individual, and closeout has been tied to an appropriate project milestone. The Project Manager will track these items to completion. The RMP will be reassessed on a quarterly basis.

5. Assessment Results

This section presents the results of the specific risk assessments that were conducted for each of the identified project areas of consideration.

Risk Assessment: CFN-1

Area of Consideration: Project scope definition

WBS Category: Project Support

Potential Event: Increases in project scope

Impact Analysis: The consequences of “scope creep” are cost increase and/or schedule delay. The expected Impact is *Low.*

Event Likelihood: *Likely.* While it is expected that scope creep will occur, the planned mitigation strategies will reduce the likelihood of occurrence and also minimize the impacts.

Mitigation Strategies: 1) Scope “programming” workshops by the A/E, 2) management oversight of project design and 3) cost and schedule contingency

Responsible Individual: M. Schaeffer, Project Manager

Closeout Date: Ongoing quarterly review during project, closeout at CD-4b Start of Operations - Technical.

Contingency: The cost contingency for the project support at level 2 is approximately 12%.

Risk Assessment: CFN-2

Area of Consideration: ES&H issues

WBS Category: Project Support

Potential Event: Unplanned ES&H issues need to be resolved.

Impact Analysis: ES&H issues, such as environmental impacts or inadequate hazard identification, can delay or even shutdown a project. The expected impact is *Low.*

Event Likelihood: *Unlikely*.

Mitigation Stratagies: The impacts of ES&H issues are well acknowledged. A Preliminary Hazards Analysis (PHA) has been developed which identifies hazards and appropriate mitigation techniques. A NEPA review of this project has been conducted and the project has been determined to be categorically excluded from further NEPA review based on negligible environmental impact. The results of both the PHA and NEPA review will be re-examined on an annual basis to provide assurance that the bases for the conclusions of these analyses have not changed.

Responsible Individual: S. Hoey, CFN ES&H Coordinator

Closeout Date: CD-4B Start of Operations - Technical

Contingency: The cost contingency for project engineering at level 3 is approximately 11%.

Risk Assessment: CFN-3

Area of Uncertainty: Technical equipment design and acquisition

WBS Category: Technical Construction

Potential Event: 1) Inadequate equipment design, 2) Procurement delays

Impact Analysis: Inadequate selection, poorly specified, or obsolescent instrumentation will be detrimental to the achievement of outstanding science results. Procurement and manufacturing delays could impact the project schedule. The instruments are commercially available, many are off-the-shelf and some will be built to customized specifications. The technical risks are low and there is no R&D effort associated with the CFN instrument design. The expected impact is *Low.*

Event Likelihood: *Likely.* Some adjustments in equipment specifications are anticipated prior to completion of the CFN. While it is possible that these events may occur, their impact is minimized by implementation of appropriate mitigation strategies.

Mitigation Strategies: 1) Cost and time contingencies are provided, 2) Workshops and other outreach activities have been, and will continue to be, held to elicit feedback from the user community. 3) Appropriate procurement controls will be applied to ensure quality, delivery and reliability of the instruments.

Responsible Individual: A. Moodenbaugh, Technical Construction Coordinator, and D. Dale, Technical Procurement Manager

Closeout Date: CD-4B Start of Operations - Technical

Contingency: The technical construction contingency at level 2 is approximately 24%.

Risk Assessment: CFN-4

Area of Consideration: Facility Design

WBS Category: Project Engineering - Construction

Potential Event: Design changes

Impact Analysis: An inadequate or poorly thought out facility design will result in inefficient or less than optimum science results. Design changes may increase cost or delay completion. The expected impact is *Low*.

Event Likelihood: *Likely.* While some redesign is expected, its impact is minimized by implementation of the planned mitigation strategies.

Mitigation Strategies: 1) An Architect/Engineer with laboratory and nanoscience design experience will be selected and frequent design meetings will be held, 2) interactions with existing NSF university nanocenters and the other DOE NSRCs

have been and continue to take place, 3) a design will be provided that has flexibility in laboratory layout and an expandable "footprint."

Responsible Individual: M. Fallier, Conventional Construction Manager

Closeout Date: CD-3 Start of Construction and Procurement

Contingency: The project engineering contingency at level 2 is approximately 11%.

Risk Assessment: CFN-5

Area of Consideration: Conventional Construction

WBS Category: Conventional Construction

Potential Event: 1) Schedule issues or 2) construction problems

Impact Analysis: Schedule inadequacies, poor construction management, or other factors can result in schedule slippage and milestone delays. These are expected event occurrences on a construction project and normal project controls are applied, e.g., cost and schedule contingency. The expected impact is *Low.*

Event Likelihood: *Likely.* Implementation of planned mitigation strategies will minimize impact.

Mitigation Strategies: 1) Apply cost and schedule contingency, 2) evaluate schedule and variances on an ongoing basis, 3) use experienced BNL staff for construction management.

Responsible Individual: M. Fallier, Conventional Construction Manager

Closeout Date: CD-4A Start of Operations – Building

Contingency: The contingency for conventional construction is approximately 17%.

Risk Assessment: CFN-6

Area of Consideration: Cost estimate and budget management

WBS Category: Project Management

Potential Event: Poor budget management

Impact Analysis: Inadequate cost estimates and/or poor budget management will result in cost over runs. However, the preliminary and performance baseline process provide assurance that an adequate cost estimate is developed and project management oversight and reporting provide budget control. The expected impact is *Low.*

Event Likelihood: *Likely.* Implementation of planned mitigation strategies will minimize impact.

Mitigation Strategies: 1) Cost contingency application to the project budget, 2) Project Management oversight

Responsible Individual: K. Koebel, Cost Control Manager

Closeout Date: CD-4B Start of Operations – Technical

Contingency: The overall project cost contingency at level 1 is approximately 20.8%.

Risk Assessment: CFN-7

Area of Consideration: Policy requirements and Stakeholder issues

WBS Category: Project Management

Potential Event: Concerned stakeholder creates a hold on project.

Impact Analysis: Inadequate integration of policy requirements into project design, or failure to properly address stakeholder needs/concerns can result in funding delays and poor public relations. The impact is *Low.*

Event Likelihood: *Likely.* Since policy requirements change and stakeholder concerns arise at any time, effective mitigation measures need to be in place.

Mitigation Strategies: 1) Public workshops to identify stakeholder needs or concerns, 2) ongoing meetings with other NSRC Directors and DOE BES to address and coordinate incorporation of policy issues, 3) CFN website and newsletter to advise stakeholders of important CFN activities.

Responsible Individual: R. Hwang, CFN Director

Closeout Date: Project completion at CD-4B Start of Operations - Technical, although the resolution of policy requirements and stakeholder issues is an ongoing activity.